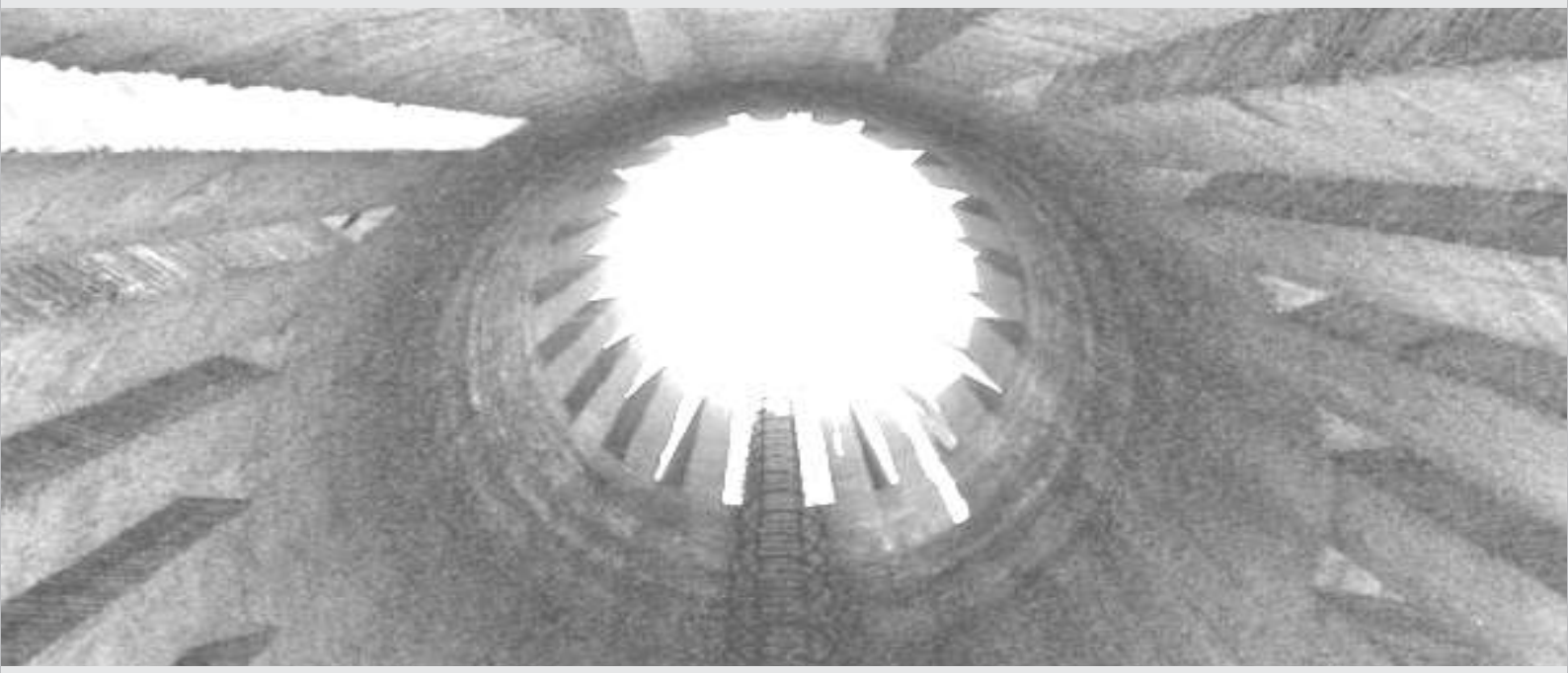
7th Balkan Mining Congress



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MONITORING OF SEISMIC ACTIVITY OF THE EARTH DAM TOPOLNICA – MINE BUCHIM, REPUBLIC OF MACEDONIA

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ABSTRACT

Blasting, whether pointwise, linear, individual or massive, are treated as small earthquakes. So, it is known in advance the place and time of the earthquake, and the energy of the blasting, we know, is much less than the energy in the earthquake.When blasting, in the first phase, the solid matter of the explosive is transformed in the compressed gaseous state, and then the gas is spreading, whereby the potential energy turns into mechanical work. This energy at the site of blasting, ruining, crushing rock masses, creates permanent deformations in the rock. Seismic waves, which are spread by the transfer of the deformation, cause oscillation of the ground and the objects.Seismic waves that occur during blasting are similar on the waves that occur in earthquakes, so many seismic blasting uses many laws that are defined in seismology. Modern instruments transform these movements, i.e. oscillations into electrical motions, and as such they register them on photo-paper or digitize them and record them on a magnetic tape. In this paper is present monitoring of the seismic activity of the earth dam Topolnica near the mine Buchim.

Key words: monitoring, seismic activity, equipment, registration

1. INTRODUCTION

Every object with appropriate structural features, acts as an oscillatory system and is subject to the action of earthquakes. But at the same time, it is (can be) influenced by changes in the geodynamic conditions of the environment where such an object is built. If they are monitored within a certain periodof time, the changes in certain ambient parameters of the object's vibration can provide very important data that can be in appropriate relation with its structural parameters. The monitoring of the seismic activity of the dam and its surroundings, as well as the dynamic response of the dam as an oscillatory system, will largely depend on the installed seismological equipment and its operation.

Installing seismological equipment at certain locations is due to:

- Monitoring the local or regional seismicity of the area where the seismological station is located.

- Monitoring the action of strong earthquakes that are expected to occur on, or around the selected site, dam, bridge or other capital facility.
- Measuring ambient vibrations of the object being monitored.

2. SEISMICITY OF THE AREA OF MINE BUCHIM

Location of the dam Topolnica is in area of mine Buchim, in Radovish epicentral area, that belongs to Eastern Macedonian zone on the territory of the Republic of Macedonia (fig. 1). From the previous investigations of the regional seismicity on the territory of the Republic of Macedonia. Macedonia and the border areas, it has been shown that strong earthquakes have not been recorded in this area so far. But due to the high seismic activity of the neighboring epicenter are as where very strong earthquakes have occurred in the last 100 years (theValandovo epicentral area and the area of Pehchevo-Kresna), the Topolnica dam will be exposed to the effects of future earthquake sinthese areas. [1]

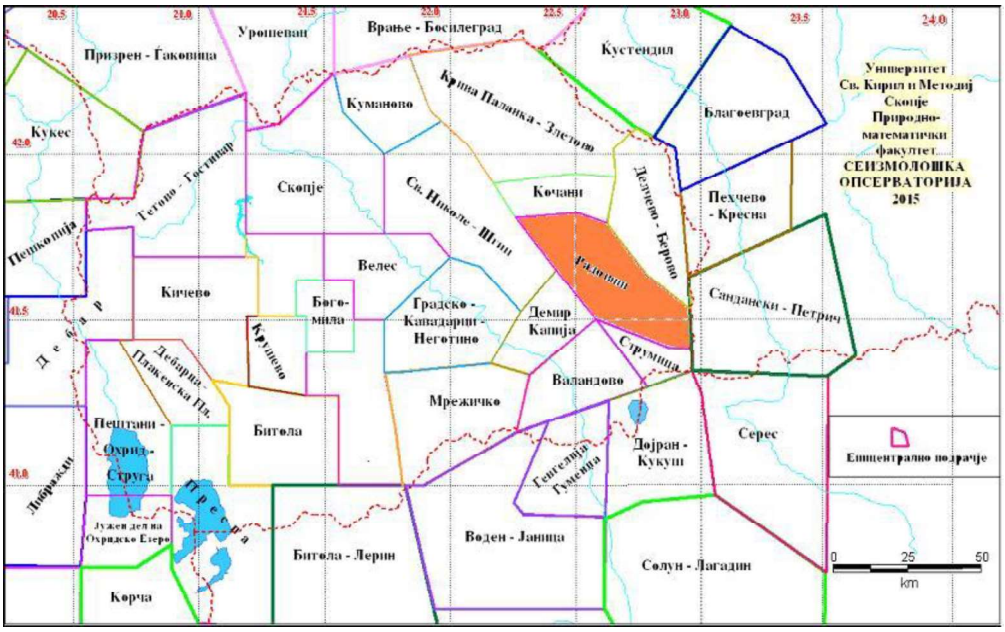


Figure 1. Map of the boundaries of the epicentral areas on the territory of the Republic of Macedonia and the surrounding areas. Radovish epicentral area is marked separately

On Fig. 2, is given the epicentral map of earthquakes from the territory of the Republic of Macedonia, which happened in 2015. The clustering of epicenters of earthquakes is clearly seen (which are relatively stronger than those in the Radovish epicenter area) [2].

By installing highly sensitive seismological equipment in these ismological stations on the territory of the Republic of Macedonia and the neighboring countries, and especially after the installation of these ismological stationon Plachkovica in 2012, it has also been shown that Radovish epicenter area is characterized by high seismicity, followed by a number of weak earthquakes.

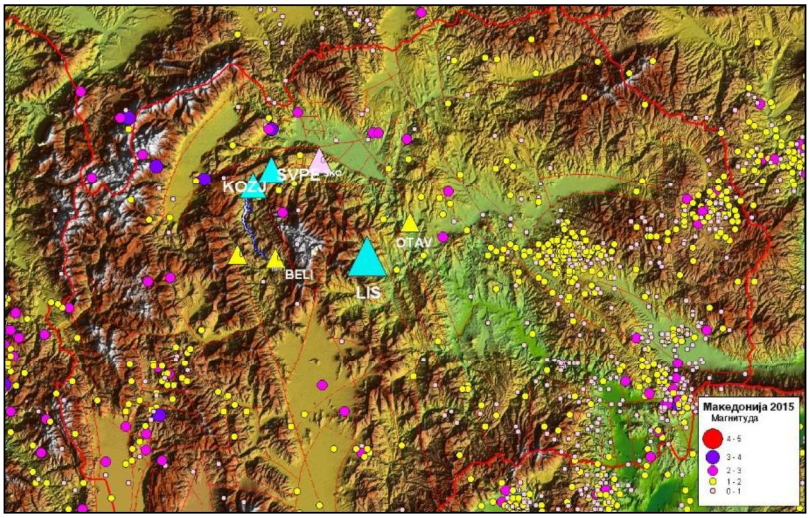


Figure 2. Epicentral map of Macedonia for 2015

This is clearly seen in Fig. 3, which shows the epicenter of earthquakes from the Radovish epicenter region, in the period from 2013 to 2015. The location of these ismic station of Plachkovitsa (STIP), as well as the location of these ismic monitoring system of the Topolnica dam (TOPL) are shown.

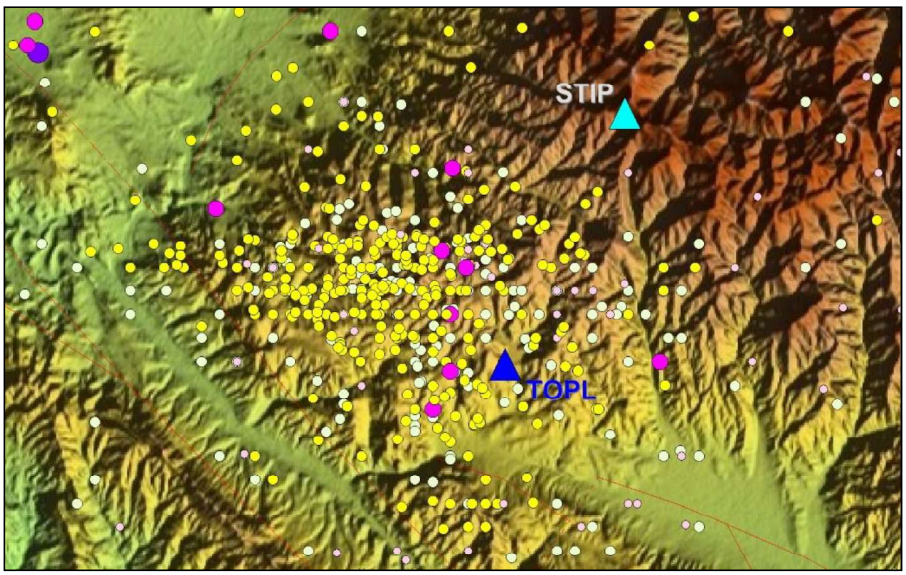


Figure. 3.Epicentral map for registered earthquakes in the period 2013-2015 in the area between the locations of these ismological stations in Stip (STIP) and damTopolnica (TOPL).

2. INSTALLED SEISMOLOGICAL EQUIPMENT AND REGISTRATIONS

Digitexx's installed seismological equipment is mainly designed to monitor the effects of strong earthquakes. These are three accelerometers with the accompanying analogue / digital equipment and serve to register the shift to the ground. They are placed in three measuring points: S1, S2 on the dam crown and S3 at 100 m from the dam crown (Fig. 4).

Figure 4. The locations of the three measuring points on damTopolnica (S1, S2 and S3)

The whole system is in a state of waiting for an earthquake or other waves that would satisfy the activation parameters of the built-intrigger, which would make such an event possible.

In order to demonstrate the capabilities of these ismological stations, the received registrations have separated the registrations of locale earthquakes, but also the registration of very close events to the very locations; S1, S2 and S3.

Presented registrations are represented on figures 5 and 6. They clearly pointed on different geomechanical characteristics of the ground in the three measuring points. Sufficient strong waves are registered in all three places (Fig. 5), but with very poor motions / earthquakes, registrationin S3 is absent (Fig. 6). This requires adjusting the dynamic characteristics of the instrument at the measuring point S3. [3]

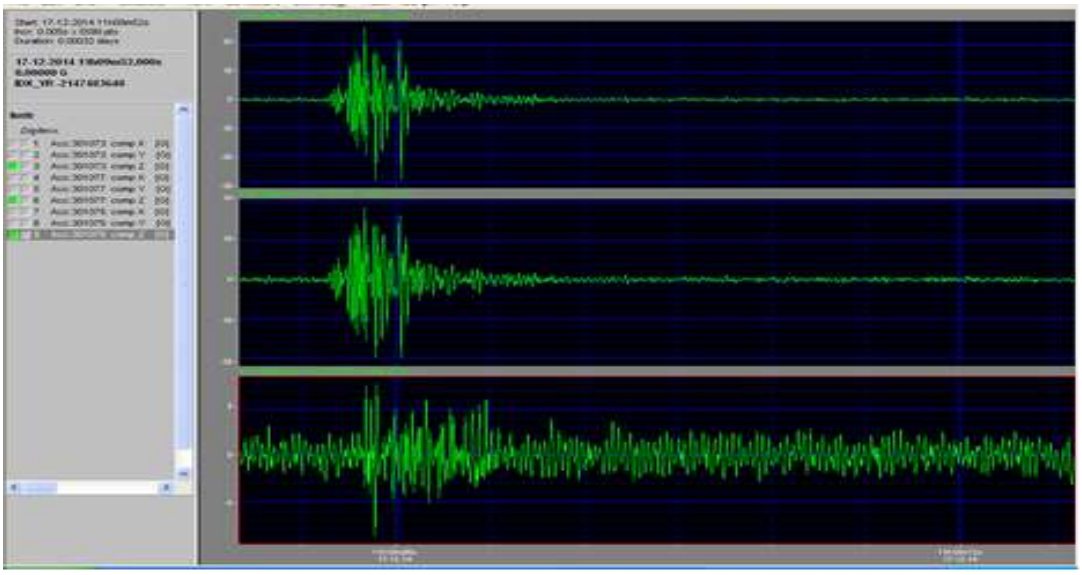


Figure 5.Local earthquake. Registrations of horizontal Z components in the measuring points S1, S2 and S3 on damTopolnica(17.12.2014, 11:09).

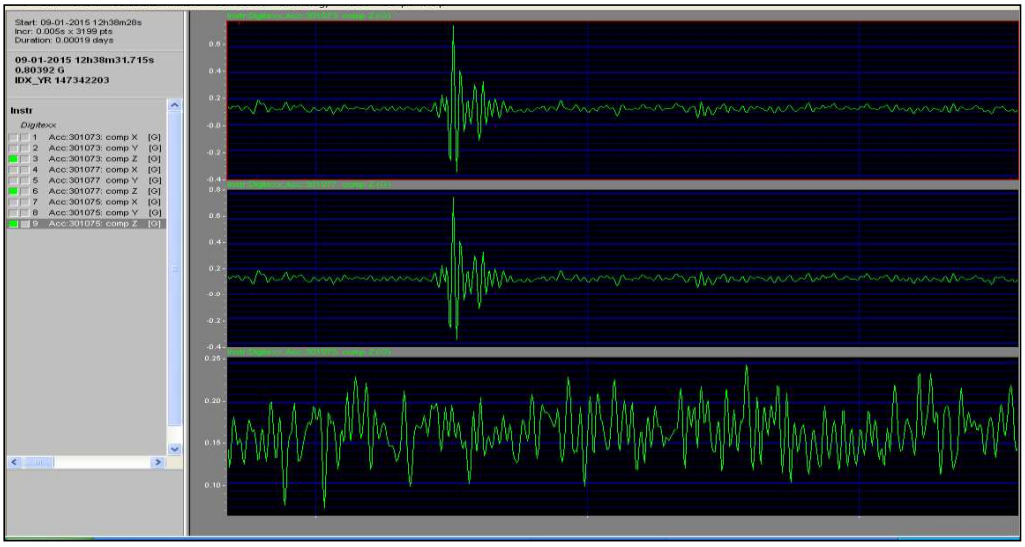
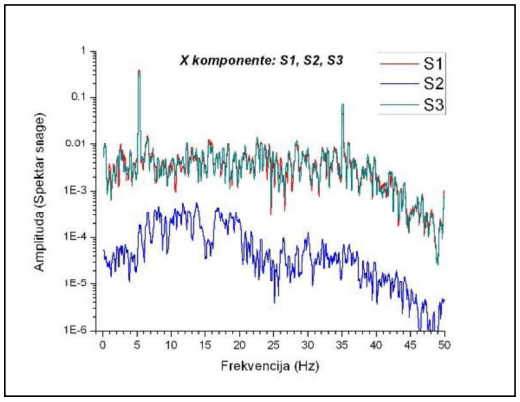
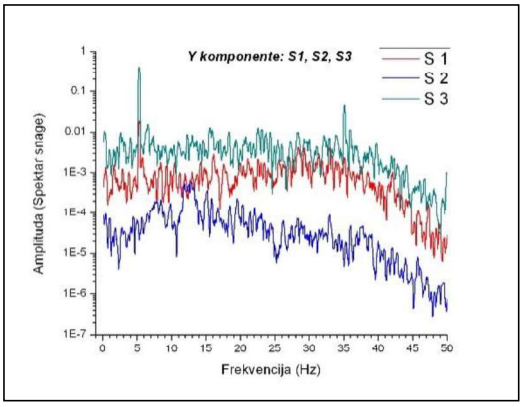


Figure 6.Very close earthquake. Registrations of horizontal Z components in the measuring points S1, S2 and S3 ondamTopolnica (09.01.2015, 12:38)

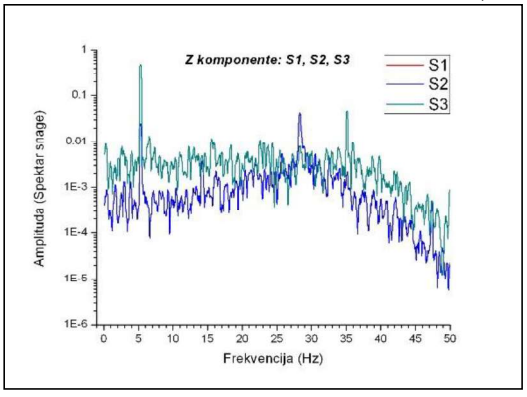
In order to monitor the changes in the dynamic characteristics of the dam Topolnica, the spectra of ambient vibration of the dam are of great importance. Registration of ambient vibration is selected from 22.01.2015 (fig. 7). From this registration, the spectra of power are made and immediately the characteristics are detected in the individual measuring points. [4]



a) X components



b) Ycomponents



c) Zcomponents

Figure 7. Spectra of power on the ambient vibration at the dam Topolnica

3. CONCLUSION

The installed seismic instruments satisfy all standards for monitoring the effect of strong earthquakeson the dam Topolnica, as well as, if necessary, monitoring the changes in health, from a dynamic and static aspect, to the whole building itself.

Clear clustering of the epicenters of weake earthquakes in the immediate environment of the Topolnica dam (Fig. 3) indicates the need to monitor the registrations of this system, in the process of determining the locations of local and very nearby earthquakes. This also requires continuous registration of the seismic activity of the dam, archiving and processing of data.

By obtaining seismic data from these ismological station installed precisely in this epicenter area, it will be possible to determine more precisely the spatial distribution of the hypocentres of locale arthquakes.

This will enable the determination of local seismogenic sources, an important data in the micro-resettlement of the location of the Topolnica dam, as well as in the wider area, an important factor for the present and future work of the Bucim mine.

Regular monitoring of the changes in the spectral characteristics of ambient vibrations at the Topolnica Dam is of great importance for monitoring the current state of the object (its structural health), but also to anticipate some future problems that may arise after the action of earthquakes or as the re sult of changes in the local conditions of the location where the facility was built (due to exploitation, weather disasters, etc.).

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